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Research Article

Community perceptions of ecosystem services, drivers of degradation, and proposed conservation actions for Denbiq Wetland in West Gojam, Ethiopia

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Abstract

Denbiq Wetland, located in Bure Woreda of West Gojam, Ethiopia, provides essential ecosystem services that support local livelihoods and biodiversity. This study assessed the wetland's ecological functions, the socio-economic factors contributing to its degradation, and community-driven conservation strategies. Primary data were collected through structured questionnaires, interviews, focus group discussions, and field observations from a randomly selected sample of 202 households. Descriptive statistics and binary logistic regression were used for analysis. The findings show that the wetland offers diverse ecosystem services, including provisioning (freshwater, fodder, fruits), regulating (water purification, temperature control), cultural (recreation, tourism), and supporting (habitat, organic matter accumulation) functions. Logistic regression revealed statistically significant influences ($p < 0.01$): household size was negatively associated with wetland condition, while landholding size and age had positive impacts. Key drivers of degradation include agricultural expansion, overgrazing, reduced upland crop productivity, and limited grazing land. The local community showed strong awareness of, and support for, interventions such as awareness campaigns, establishing buffer zones, and grazing control. These findings underscore the need for integrated, community-based and policy-supported wetland management to maintain ecosystem function while supporting rural livelihoods.

Key words: Denbiq, drivers of change, ecosystem services, sustainable use, wetland management

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Introduction

Wetlands are among the most valuable and fragile ecosystems on Earth, providing a wide array of ecological, economic, and cultural benefits (Xu et al. 2019). They regulate hydrological cycles, support biodiversity, sequester carbon, moderate local climate conditions, and contribute to food and water security (Junk et al. 2013; Lamsal et al. 2015). Wetlands provide four major categories of ecosystem services: provisioning services (e.g., freshwater, fodder, fuelwood, wild food); regulating services (e.g., climate regulation, flood control, water purification); cultural services (e.g., recreation, spiritual significance, education); and supporting services (e.g., nutrient cycling, habitat provision, soil formation) (Wallace 2007; Junk et al. 2013).

Globally, the perception of wetlands has changed significantly over the last few decades. Formerly dismissed as unproductive "wastelands," they are now recognized for their ecological significance and socio-economic value (Martinez-Juarez et al. 2015; Darwall et al. 2018). In Ethiopia, wetlands have long played a role in supporting rural livelihoods through resource provision, ecological regulation, and cultural importance (Wondie 2018). Yet despite this importance, many Ethiopian wetlands are under accelerating pressure from agricultural expansion, settlement growth, water diversion, and infrastructure development (Gebresllassie et al. 2014). Underlying drivers include rapid population growth, weak and fragmented environmental governance, market failures linked to the undervaluation of ecosystem services, and insecure land tenure (Hoe and Lian 2021). These pressures are exacerbated by limited hydrological data, poor watershed management, and a general lack of monitoring and enforcement capacity (Giweta 2018). Although there has been growing awareness of wetlands' importance, conservation efforts often remain fragmented and reactive, rather than proactive and integrated.

A persistent barrier to effective wetland management in Ethiopia is the failure to bridge scientific assessments with local community knowledge and participation (Kakuru et al. 2013; Giweta 2018). Most conservation efforts have either ignored or insufficiently incorporated community perspectives, resulting in limited impact. Top-down conservation initiatives that overlook local values and livelihood realities often achieve limited long-term impact. Moreover, interventions framed around ecosystem services are seldom evaluated for socio-economic outcomes, reducing opportunities for adaptive management. Addressing these gaps requires site-specific, participatory assessments that combine ecological, socio-economic, and governance dimensions.

Denbiq Wetland, located in the West Gojam Zone (Bure Woreda) of the Amhara Region, exemplifies these challenges. The wetland supplies freshwater, grazing land, medicinal plants, and cultural and spiritual value for local communities. However, it faces mounting pressures, including agricultural encroachment, nutrient loading from nearby farms, loss of native vegetation, and pollution. Although local awareness exists, conservation measures remain fragmented, inconsistent, and weakly institutionalized. Despite some local awareness of the wetland's importance, conservation actions have been inconsistent and insufficient. Scientific data on the wetland's ecological status are scarce, and existing initiatives lack coordination and long-term vision. Moreover, policies and interventions have tended to be top-down, with minimal community involvement or contextual adaptation, further limiting their effectiveness.

While various threats to Ethiopian wetlands have been broadly recognized in policy and literature, there remains a critical research gap in site-specific, integrated assessments that combine both ecological data and local knowledge (Aazami and Shanazi 2020). Existing studies often focus on biophysical changes or land cover dynamics in isolation, while overlooking the social dimensions and local drivers of wetland transformation. Moreover, many past interventions whether government-led or externally funded have lacked continuity, failed to gain community ownership, or did not address the socio-economic incentives that fuel unsustainable use.

In the case of Denbiq Wetland, there is limited empirical research evaluating its ecosystem services, degradation drivers, or local conservation knowledge.

Although some efforts have been made to raise awareness and promote sustainable practices, they have not been systematically assessed or widely implemented. As a result, degradation persists, and the wetland's potential to support both ecological and human systems is increasingly compromised.

This study addresses these gaps through an integrated, community-based assessment of Denbiq Wetland. Specifically, it: (i) characterizes household socio-economic conditions and dependence on wetland resources; (ii) documents community perceptions of ecosystem services across provisioning, regulating, cultural, and supporting categories; (iii) identifies perceived drivers of wetland degradation; (iv) tests socio-economic predictors of wetland sustenance/degradation using binary logistic regression; and (v) documents locally proposed conservation and management interventions. The research findings will offer concrete recommendations that can inform future conservation planning, not only for Denbiq Wetland but also for other similarly threatened wetlands in the Ethiopian highlands.

Materials and methods

Description of the study area

The study was conducted in Denbiq Wetland, located in Bure Woreda, within the West Gojam Zone of the Amhara Region, North West Ethiopia. Geographically, the area lies at 10°42'N and 37°4'E, approximately 415 km northwest of Addis Ababa and 150 km southwest of Bahir Dar. The wetland covers an estimated 3,123 hectares, and primarily fed by the Denbiq spring, surface runoff, and seasonal precipitation from the upper catchment.

The region receives an annual rainfall ranging from 1386 to 1757 mm, following a monomodal rainfall pattern concentrated between May to September (Erkihun et al. 2015). This rainfall pattern, combined with the varied elevation 713 to 2604 meters above sea level, creates distinct agroecological zones, moist and wet lowland (10%), wet Woina-Dega (82%), and wet Dega (8%) (Adamu et al. 2019). These zones significantly influence wetland hydrology through runoff volume, infiltration rate, and erosional potential. For instance, steep slopes in highlands contribute to sediment deposition, while intensive land use in the lower areas affects the wetland's natural retention capacity and groundwater recharge.

Temperature ranges from 14 °C to 24 °C annually, supporting diverse agricultural practices. The surrounding land is heavily cultivated, and the proximity of farming activities to the wetland accelerates nutrient loading and vegetation loss, particularly in the northern part, which is degraded due to crop encroachment and overgrazing (Fig. 1). In contrast, the eastern sections retain native shrubs and grasses that provide habitat for wetland fauna.

Socio-economically, Bure is primarily agrarian, with the majority of the population engaged in mixed crop-livestock farming. Major crops include maize, teff, sorghum, and barley, cultivated in a subsistence-oriented farming system. Landholding sizes are generally small, and population density is relatively high, which places intense pressure on natural resources, including wetlands. Community dependence on Denbiq Wetland is high, with local livelihoods benefiting from water supply, grazing land, traditional medicine, and seasonal wild harvests. However, limited awareness and lack of formal management structures have made the wetland vulnerable to unsustainable use and degradation.

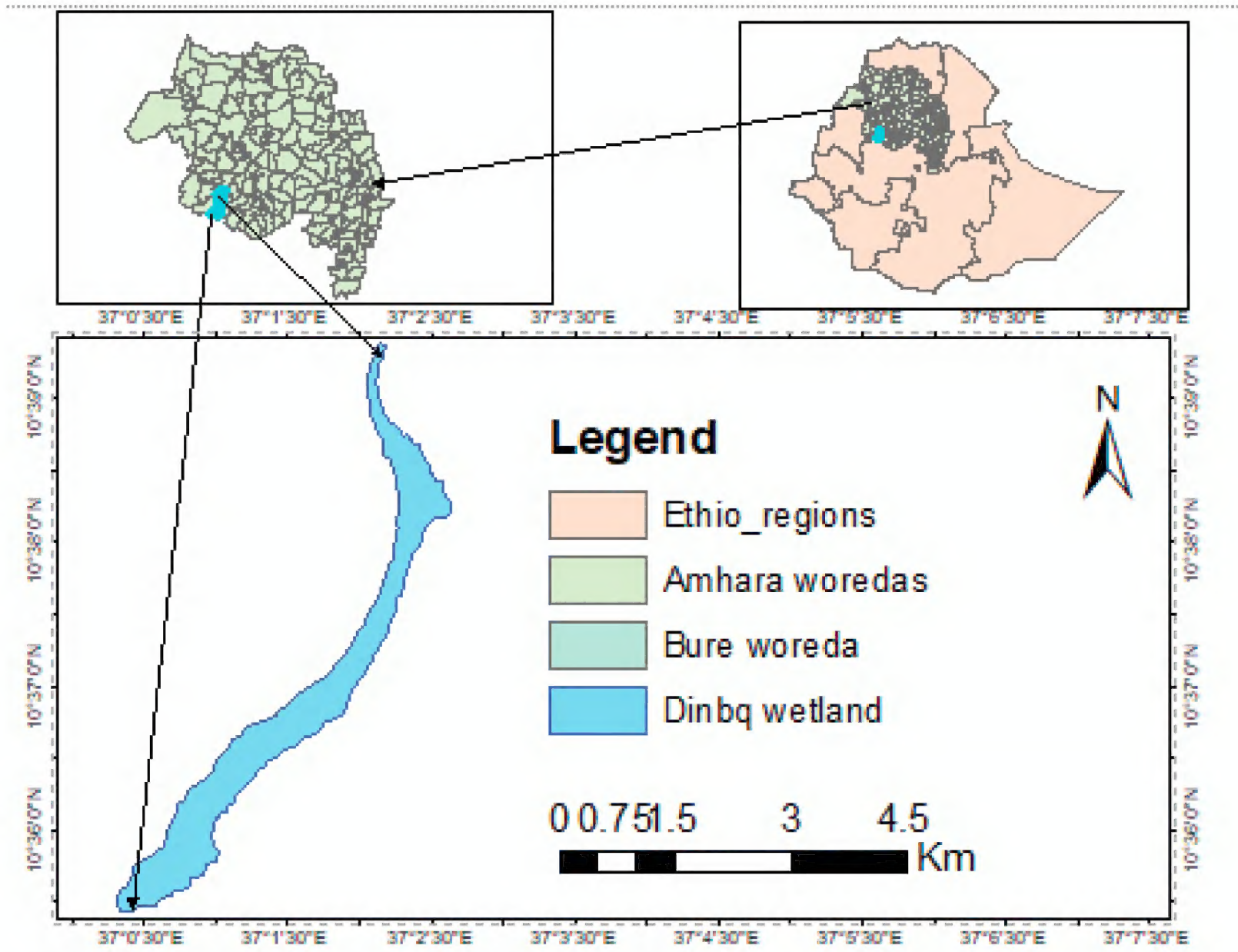

Figure 1. Map of the study area.

Research design and data collection

The study was carried out in four selected kebeles Wadera, Denbun, Tiya Tiya, and Alfa. These Kebeles were deliberately selected based on three criteria: 1. The extent of wetland area within each Kebeles, 2. Intensity of wetland utilization for agricultural and pastoral purposes, and 3. The community's perceived reliance on wetland ecosystem services. This stratified selection ensured representation of gradients in pressure and use intensity. The research employed the ecosystem service classification proposed by Wallace (2007), which divides services into provisioning, supporting, regulating, and cultural categories. Data collection includes household survey, focus group discussions, key informant interviews, and field observations. For the households' survey respondents were randomly sampled to ensure proportional representation from each kebele. Structured questionnaires were used to collect data on demographic characteristics, livelihood strategies, perceptions on wetland benefits, and awareness of conservation practices. The questionnaire was adapted from Anderson and Davis (2013) translated into the local language, and refined through a preliminary pretest to ensure clarity and cultural relevance.

A combination of data collection methods was employed. Focus group discussions were conducted in each kebele, with six to eight participants chosen based on their reliance on wetland resources. Four FGDs were held in total one per kebele balancing diversity and logistical feasibility, while ensuring representation across gender, age, and livelihood groups. Each discussion followed a structured guide covering wetland services, change trends, and drivers of degradation.

Twelve key informants were selected purposively, including local elders, development agents, agricultural office, and community leaders. The number was chosen to ensure coverage of key stakeholder perspectives while maintaining depth of engagement. Qualitative data from FGDs and key informants were analyzed using thematic content analysis. Transcripts were reviewed, coded manually, and grouped into thematic categories reflecting perceptions, drivers of change, and suggested conservation actions. This allowed for systematic interpretation of patterns across interviews.

Field observations were conducted in two phases: a preliminary site visit for logistical planning, and a detailed survey during primary data collection to observe environmental conditions, land use patterns, and vegetation cover. These observations helped validate community responses and triangulate data.

Sample frame and sampling techniques

Four sample Kebeles surrounding Denbiq wetland were included in the sampling frame. Household respondents were selected using simple random sampling proportional to kebele household population. Sample size was determined using Yamane (1976) formula at ± 7% precision and 95% confidence level:

$$\mathrm{n} = \frac{N}{[1 + N(e2)]}$$

Where n is the required total sample size of respondents, N is the total household (22771) in all sample Kebeles, e is the minimum level of precision (0.07), where the confidence level is 95% at *P* = ± 5 (maximum variability).

$$\mathrm{n} = \frac{22771}{[1 + 22771(0.0049)]} = 202$$

Accordingly, a total of 202 households, 50 (24%) from Alefa kebele, 44 (21.5%) from Tiya Tiya, 60 (32%) from Denbun, and 47 (22.5%) households from Wadera kebele were randomly selected for interview (Table 1). In addition, 12 key informants and four Focus group discussions (each group consisting of 6 individuals) were involved and participated in the study. Members of the Focus group discussions were selected purposively.

Data analysis

The data collected from the household survey were analyzed using the Statistical Package for Social Scientists version 26.0. The analysis involved both descriptive statistics and logistic regression to interpret the findings effectively.

Table 1. Total household heads (HHH) and sampled respondents by kebele.

Kebeles	Total HHH	Sample HHH		
		Males	Females	Total Percentage (%)
Alefa	5,563	46	4	24
Tiya Tiya	4,575	38	6	21.5
Wadera	5,326	42	5	22.5
Denbun	7,307	54	6	32
Total	**22,771**	**181**	**21**	**100**

Descriptive statistics were used to summarize general trends, while a binary logistic regression model was applied to explore relationships between variables. This approach provided a comprehensive understanding of both broad patterns and deeper variable interactions. The regression model utilized was based on the linear regression framework outlined by Gujarati (2004).

$$Y = \alpha + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \beta 6X6 + \beta 7X7 + \beta 8X8 + \mu$$

where: Y = dependent variable (degradation/loss of wetlands), α = constant, X1–X8 are independent variables; that is, X1 = Location, and, X2 = age of the respondents, X3 = gender of the respondents, X4 = family size, X5 = educational level, X6 = Occupation, X7 = land size, X8 = Tropical livestock unit (TLU) and μ = error term (residual).Values β1–β8 are the parameters estimated (i.e., the respective coefficients of the independent variables X1–X8. Focusing on statistical significance and effect size allows us to identify which household factors or socio-economic characteristics played a key role in wetland degradation. Thus, a procedure was performed to test the null hypothesis, β1 = β2 = β3 = β = n, against the alternative hypothesis, which is that the null hypothesis is not true in at least one case. The data obtained from focus group discussion and field observation were written in the form of verbal/narrative information.

Results

Socio-demographic characteristics and livelihood

Understanding the demographic composition of local communities is crucial for informed policy-making, strategic planning, and effective natural resource management, particularly when it comes to the sustainable use and restoration of wetlands. In this study, structured questionnaires were administered to 202 household heads. The findings indicated that the majority of respondents came from male-headed households, comprising 89.6%, whereas female-headed households accounted for 10.4% (Table 2). The average respondent age was 40 years, with participants ranging between 25 and 61 years. Regarding educational background, 17.8% of respondents were illiterate and unable to read or write. Additionally, 26.7% had completed primary school, 36.8% had attained secondary education, and 16.8% had pursued college-level studies (Table 2). Agriculture was the primary occupation for most respondents, with 83.7% identifying as farmers. Other professions, such as government employment and self-employment, constituted a smaller percentage of the surveyed population have played a crucial role in providing provisioning, regulating, and cultural benefits to local communities.

A significant portion of respondents (94.5%) were engaged in crop farming, while others participated in additional economic activities, including livestock rearing (32.4%), vegetable farming (59.7%), small-scale trade (4.5%), and harvesting wetland resources such as reeds, thatching grass, and wild fruits (Table 2). While there were minor differences among the wetlands in the four kebeles, Dembun and Tiya Tiya wetlands were found to be heavily impacted by agricultural expansion, livestock grazing, drainage, and seasonal recession farming,

Table 2. Socio-demographic information of respondents (n = 202).

Sociodemographic variable	Category	Participated respondents	
		Number	(%)
Gender	Male	181	89.6
	Female	21	10.4
Age	<40	92	45.5
	41-50	68	33.7
	>51	42	20.8
Education	Can't read and write	36	17.8
	Primary education	54	26.7
	Secondary education	78	38.6
	College	34	16.8
Residence	Born	180	89.1
	Immigrants	22	10.9
Occupation	Farmer	169	83.7
	Gov't employed	6	3
	Merchant and farmer	27	13.4
Source of income	Crop production	192	94.5
	Vegetables and fruits	108	59.7
	Livestock	45	32.4
	Trade	9	4.5

particularly in the dry season. Tiya Tiya wetland lacked buffer vegetation, whereas the Debun Kebele wetland was relatively covered by the Nile grass species (*Berbeza*). Meanwhile, Alefa and Wadera wetlands were predominantly occupied by *Typha lotifolia* and *Cyperus papyrus* reed species. This consistency underscores their fundamental role in sustaining both human livelihoods and environmental well-being.

Livestock holdings, land size, and household characteristics

Household characteristics showed wide ranges (Table 3). Family size ranged from 1 to 12 persons (mean 5.19 ± 1.90). Livestock holdings (number, proxy for TLU) ranged from 0 to 19 animals (mean 7.2 ± 5.1). Cultivated land averaged 1.38 ± 0.89 ha (range 0.15–4 ha); grazing land averaged 0.59 ± 0.38 ha (range 0.10–5 ha); homestead plots 0–0.5 ha (mean 0.15 ± 0.12 ha); woodlots 0–1.75 ha (mean 0.44 ± 0.22 ha). Some households reported having no land at all and were dependent on sharecropping or common lands. Households with extensive livestock relied heavily on wetland grazing; land-poor households harvested wetland grasses (*cheff*) for sale and used wetland water for household and small-plot irrigation.

Table 3. Household characteristics, livestock population, and land holding in hectares.

Variables	Minimum	Maximum	Mean ± S.d
Family size	1	12	5.19 ± 1.9
Number of livestock	0	19	7.2 ± 5.1
Cultivated land (ha)	0.15	4	1.38 ± 0.89
Grazing land (ha)	0.1	5	0.59 ± 0.38
Homestead (ha)	0	0.5	0.15 ± 0.12
Woodlot (ha)	0	1.75	0.44 ± 0.22

Ecosystem service in Denbiq Wetland

Wetlands provide vital ecosystem services, including water filtration, flood control, carbon storage, and habitat for biodiversity. They improve water quality by trapping pollutants, reducing erosion, and supporting fisheries and agriculture. Wetlands also regulate climate by storing carbon and buffering against extreme weather, benefiting both nature and human communities. Respondents exhibited varying levels of awareness about the ecosystem services provided by the wetland (Table 4). Approximately 36.6% were not informed, while 28.2% were moderately informed. Education level and locality significantly influenced awareness ($p < 0.01$). Respondents with higher education demonstrated greater recognition of the wetland's ecological functions.

Provisioning services

The Denbiq Wetland provides a range of provisioning services that are crucial to the livelihoods of surrounding communities. The high level of recognition among respondents reflects their direct dependence on the wetland for their livelihoods. A significant portion of household's reported utilizing the wetland primarily for water-related needs water for livestock (70.9%), domestic use (60.4%), and irrigation (40%) (Table 7). Beyond water access, the wetland also supports agriculture and household economies through fodder and grazing resources (65.3%), thatching grass (48.5%), and wood for fuel and construction purposes (30.5%). A smaller proportion of respondents (10.2%) indicated the use of the wetland for medicinal plant collection, highlighting its supplementary role in traditional health practices.

These provisioning services are particularly essential in areas like Alefa and Wadera, where crop production forms the backbone of local livelihoods. This strong agricultural dependence further illustrates the community's reliance on the wetland not only as a natural resource base but also as a critical contributor to household income and food security.

Regulating services

Denbiq Wetland offers several important regulating services, including temperature regulation through carbon sequestration (50.5%), water purification (61.6%), erosion control (70.5%), and sediment retention (47.4%) (Table 7). The wetland's ability to store water during the wet season and provide it during the dry season exemplifies how wetlands support local

Table 4. Respondents' level of awareness of ecosystem services from Denbiq Wetland.

			Chi-square (χ2)		
Response	**Frequency**	**%**	**Educational level**	**Respondent locality**	
Fully Informed	23	11.4	26.6*	24.4*	
Informed	48	23.8			
Moderately Informed	57	28.2			
Not informed	74	36.6			

*χ2 significant at $p < 0.01$.

climate resilience and water management. More than 50% of respondents recognized that nearly all wetland types play a crucial role in flood regulation, water purification, and sediment retention (Table 7). The table also reveals a higher recognition of erosion control (70.5%) and a lower perception of sediment retention (47.4%). Additionally, experts and field observations noted that wetlands impacted by urbanization tend to provide stronger pollution control services.

Cultural services

The primary benefit provided by Denbiq Wetland is its cultural service. The interviewed households recognized the cultural value of the wetland, seeing it as an ideal location for recreation (60.4%), spiritual activities (35.6%), and educational and research purposes (4%) (Table 7). However, the length of time respondents had lived in the area significantly impacted their perception of the cultural ecosystem services ($P < 0.05$; Table 5) and their connection to the land.

Supporting services

A large proportion of respondents acknowledge the role of Denbiq Wetland in supporting various bird species and other wildlife, indicating that the ecological importance of the wetland goes beyond its direct benefits to humans and includes vital support for local biodiversity. The wetland provides several supporting services, such as serving as breeding grounds (45.4%) and habitats (50.2%) for wetland plants and animals, facilitating soil formation through the accumulation of organic matter (45.2%), and contributing to nutrient cycling (57.2%) (Table 7). According to the survey, Denbiq Wetland supports about 65 bird species, including the common crane, great white pelican, yellow-billed duck, Egyptian goose, African jacana, wattled crane, and crowned crane. The supporting services provided by the wetland have an indirect impact on the local population, and understanding them requires some ecological knowledge. The age of respondents was a significant factor influencing their perception of supporting ecosystem services ($P < 0.05$; Table 6). This trend may be attributed to the fact that those with higher levels of education (secondary and college) were generally between the ages of 30 and 51, making them more capable of recognizing and understanding the supporting services provided by the wetland.

Table 5. Respondents' perception of cultural ecosystem services as influenced by duration of residence in Denbiq wetland.

Age categories (Years)	Cultural Service					
	Spiritual and religious values	Recreational	Aesthetic	Educational	Total	Chi-square ($\chi2$
<40	8	29	5	11	53	25.504*
41-50	10	9	8	13	40	
>51	25	32	23	29	109	
Total	43	70	55	53	202	

*$\chi2$ significant at $p < 0.05$.

Table 6. Perception of supporting ecosystem services as influenced by respondents' age.

Age categories (Years)	supporting ecosystem service				
	Primary production	Nutrient Cycling	Soil formation	Total	Chi-square (χ2
<40	18	6	33	57	21.564*
41-50	27	12	27	65	
>51	38	8	33	80	
Total	83	26	93	202	

*χ2 significant at $p < 0.05$.

Table 7. Main ecosystem services of Denbiq wetland based on household perception.

Ecosystem service provided			
1. Provisioning	N	%	Ranks
Water for domestic use	123	60.4	3
Water for irrigation	8	40	6
Water for livestock drinking	123	70.9	1
Fodder and grazing service	35	65.3	2
Woods for fuel	7	30.5	7
Medicinal plants	11	10.2	4
Hatching grass	9	48.5	5
2. Regulating service			
Temperature regulation	42	50.5	3
Water purification	44	63.6	2
Sediment retention	34	47.4	4
Erosion control	82	70.5	1
3. Cultural services			
Recreational services	122	60.4	1
Spiritual services	72	35.6	2
Educational and research services	8	4	3
4. Supporting services			
Habitat	61	50.2	2
Nursery	15	45.4	4
Accumulation of organic matter	51	45.2	3
Nutrient cycling	75	57.2	1

Perception of driving forces of the degradation of denbiq wetlands

Several contributing factors have been identified as causes for the deterioration of the wetland, including farmland scarcity (22.3%), inadequate grazing land (86%), lack of awareness (77%), unclear boundaries (70.3%), youth unemployment (58.1%), absence of alternative livelihoods (51.9%), low productivity of nearby land (30.2%), deforestation (11.2%), sedimentation (47%), and the expansion of settlements (13.7%) (Fig. 2).

Variables such as household size, landholding size, livestock population, and age significantly influence the Denbiq wetland ecosystem, with a 99% confidence level (Table 8). Among these variables, household size was negatively associated on wetland sustainability ($\beta = -0.873$, $p = 0.006$). This implies that larger families are more likely to exert pressure on wetlands, possibly due to higher resource demands (e.g., farming land, water, and grazing), thereby contributing to wetland degradation. As family sizes increase, the likelihood of converting wetland areas for agricultural or domestic use also increases.

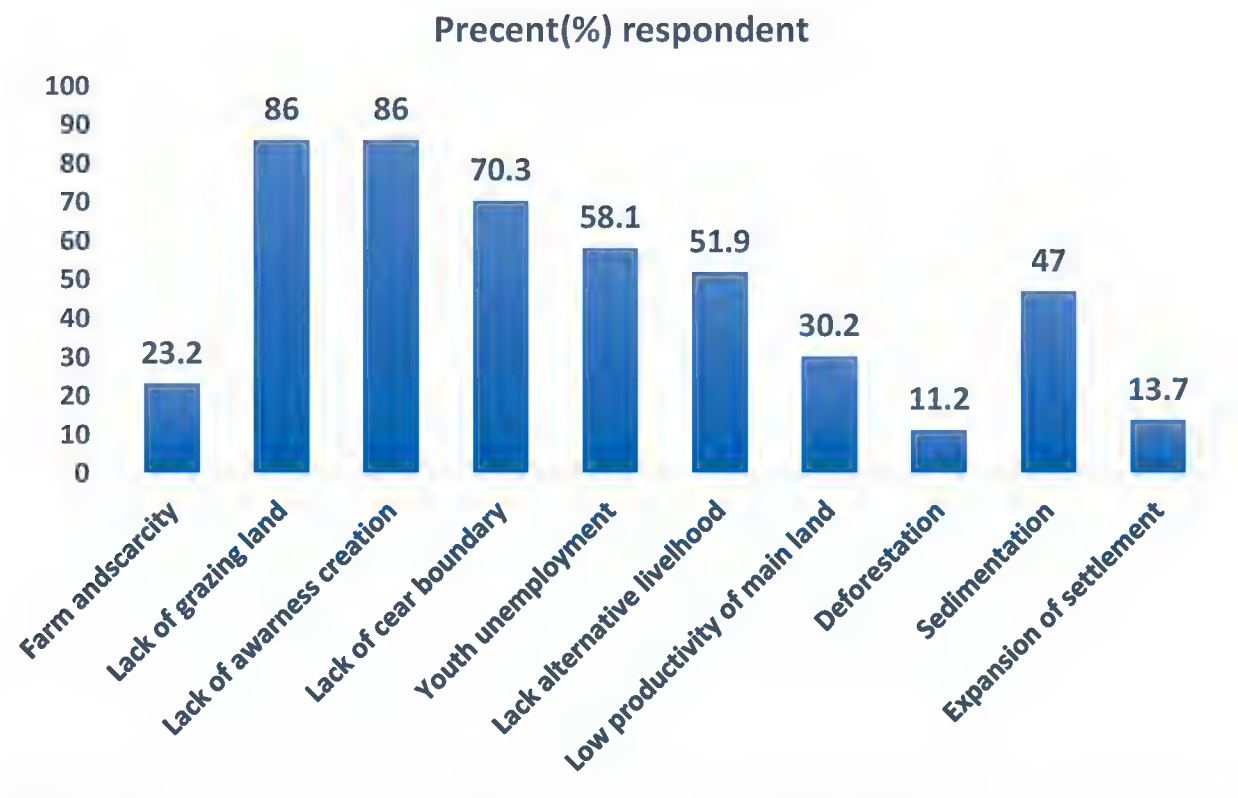

Figure 2. Major driving forces for the degradation of Denbiq wetland based on the proportion (%) of respondents.

Table 8. Binomial logistic regression for determining factors affecting wetland sustenance.

Variables	Beta coefficient			Statistics	95% C.I for EXP(B)		
	B	SE	df	Sg	EXP(B)	Lower	Upper
Location	-0.209	0.873	1	0.658	0.82	0.183	3.519
Sex	1.578	0.981	1	0.217	3.91	0.735	24.35
Age	1.932	0.808	1	0.009	5.254	1.845	14.95
Family size	-0.873	0.364	1	0.006	0.597	0.358	0.893
Educational level	1.298	1.349	1	0.023	3.852	0.326	42.463
occupation	-2.147	1.812	1	0.324	0.219	0.009	4.102
Landholding(ha)	3.025	0.903	1	0.009	8.813	1.876	40.703
Number of livestock	0.312	0.092	1	0.008	1.522	1.321	1.928
constant	0.237	2.917	1	0.987	1.892		

a. Dependent variable: Wetland sustenance/degradation)

Conversely, the age of the household head showed a positive and significant effect ($\beta = 1.93$, $p = 0.009$). Older individuals are more likely to support wetland conservation, possibly due to greater ecological knowledge, cultural connection, or experience with the long-term benefits of wetlands. Landholding size was also positively associated with wetland sustainability ($\beta = 3.02$, $p = 0.009$). Households with more land are less likely to encroach upon wetlands for farming or grazing, as they have alternative areas for these activities (Table 8). This suggests that larger household sizes are associated with a higher likelihood of utilizing wetland resources and contributing to its degradation. The number of livestock owned positively influenced wetland use ($\beta = 0.31$, $p = 0.008$), suggesting that livestock-dependent households are more likely to depend on wetland resources such as water and forage. Although this relationship is positive, it also implies potential overuse, as increased livestock grazing can lead to wetland degradation if not managed properly. These findings suggest that demographic and socioeconomic variables play a critical role in influencing community interactions with wetlands. Conservation strategies should therefore target large households, younger and less experienced land users, and households with significant livestock holdings through education, livelihood diversification, and wetland-friendly land-use planning.

Actions recommended by the local community

A significant portion of respondents were well-informed (11.4%), informed (23.8%), or moderately informed (28.2%) about the challenges facing Denbiq Wetland and potential solutions (Table 4). Key conservation measures proposed by respondents include raising awareness (64%), reducing grazing around the wetland (41%), developing buffer zones (38.39%), preventing deforestation (12.42%), installing shoreline fencing (49.23%), and regulating the use of wetland water for irrigation (3%) (Table 9). Many respondents emphasized the importance of educating both the local community and the wider public on the numerous benefits wetlands provide, such as water purification, flood control, supporting biodiversity, and carbon sequestration.

Table 9. Wetland conservation measures suggested by respondents.

Wetland conservation measure	Frequency	Percent
Awareness creation	75	64
Reducing grazing around the Wetland	53	41
Develop buffer zones	44	38.39
Avoid deforestation	24	12.42
Shoreline fencing	64	49.23
Controlling the use of wetland water for irrigation	12	3

Discussion

The study assessed community perception of ecosystem services, degradation drivers, and conservation action concerning Denbiq wetland, in West Gojam, Ethiopia. The results confirm the wetland's importance in supporting local livelihoods, mainly through provisioning services such as water for irrigation, grazing, and raw materials. This service aligns with the studies conducted in other parts of Ethiopia, such as the Fogera and Zegie wetlands where provisioning service benefits dominate local use and perception (Gibru and Biru 2022; Boru et al. 2024). Wetlands are crucial ecosystems that provide a broad range of essential services, benefiting not only local communities but also the broader environment (Thapa et al. 2020). The significant contributions of these ecosystems to human livelihoods are well-documented in various studies (Yilma 2019; Zekarias et al. 2021; Camacho-Valdez et al. 2022).

Most respondents indicated that their primary livelihood depends on wetland's resources, particularly for crop production and livestock rearing (Turyahabwe et al. 2013; Porte and Gupta 2017). This reliance makes the community highly vulnerable to any changes in the wetland's ecological functions. However, while provisioning services were most frequently mentioned, regulating and supporting services received limited recognition. This reflects a common trend in rural communities where direct and tangible benefits are more easily recognized than indirect or long-term ecological functions (Taiwo 2013; Tari et al. 2022). In addition to provisioning services, Denbiq Wetland provides valuable cultural ecosystem services. Traditionally, the wetland hosted local rituals, served as a recreational space, and symbolized communal identity. However, respondents noted a decline in cultural values, which they attributed to youth migration, the influence of formal education, and religious shifts. Similar patterns of cultural service

degradation due to modernization and land use changes have been observed in other wetland systems (Daw et al. 2011; Turyahabwe et al. 2013). Reviving these services may require integrating traditional knowledge into current conservation practices and increasing youth engagement in heritage preservation.

Institutional and policy-related gaps emerged as a critical factor in the Denbiq Wetland. While some government and community-led conservation action existed, their impact has been limited, by weak enforcement, unclear mandate among responsible bodies, and lack of coordination. Key drivers identified through surveys and focus group discussions include agricultural expansion, overgrazing, sedimentation, and the unsustainable use of wetland resources (Jing et al. 2008; Noriko et al. 2012). Focus group participants and key informants noted the wetland's declining size and water levels, which they attribute to agricultural activities and unsustainable practices. Respondents expressed concerns over the absence of clear wetland ownership and accountability, leading to open access exploitation. National policies such as Ethiopia's Wetland Strategy under the Ministry of Water and Energy provide frameworks, but implementation at the local level remains insufficient. The need for stronger institutional mechanisms, including community-based governance and inter-sectoral coordination, is evident and has been emphasized in other wetland governance literature (Wood and Baker 2023; De Oliveira et al. 2024).

Drivers of degradation identified by communities include agricultural encroachment, overgrazing, siltation, and vegetation clearance. These findings are consistent with studies that link wetland degradation in Ethiopia to intensified land use and weak land tenure systems (Marambanyika et al. 2021). Climate variability also plays a role, particularly with changing rainfall patterns affecting water availability. Addressing these drivers requires a blend of technical interventions such as restoration and buffer zone establishment and institutional measures like land use planning and environmental education.

Despite efforts by some local actors to initiate conservation, the study revealed limited awareness of ecosystem service trade-offs and degradation consequences. This gap underscores the importance of participatory approaches in wetland management, where local knowledge is integrated with scientific expertise. Strengthening awareness through community training, participatory mapping, and school-based environmental programs could foster long-term stewardship. Finally, while the study provided valuable insights into community perceptions and priorities, it is important to acknowledge its limitations. The data were collected during a single season and may not reflect temporal variations in ecosystem service use or degradation intensity. In addition, perspectives from stakeholders outside the immediate community such as regional planners or NGOs were not fully explored. Future research could expand on these areas, incorporate longitudinal data, and examine ecological assessments in tandem with socio-economic insights.

Conclusion

Denbiq Wetland plays a vital role in providing essential ecosystem services that support the well-being and livelihoods of local communities, including provisioning, regulating, cultural, and supporting functions. However, the wetland is facing significant degradation due to unsustainable practices such as overgrazing, agricultural expansion, sedimentation, and overuse of resources. Despite its value,

the wetland is rapidly deteriorating endangering biodiversity and human welfare. Encouragingly, a large majority of households expressed willingness to support conservation and restoration efforts. Suggested interventions include enhancing upland cropland productivity, creating alternative livelihoods, raising awareness, installing shoreline fencing, and conserving the wetland. A comprehensive approach that combines restoration, sustainable management, and community-based strategies is essential for preserving the Denbiq wetland and ensuring its long-term health and ecosystem services. The key finding of this study is the need for stronger institutional coordination and enforcement mechanisms. Current governance frameworks do not adequately address wetland related challenges, leaving these ecosystems vulnerable to exploitation. Study Limitation: The data collection was conducted in a single season, which may not capture temporal variations in wetland usage. Future effort must incorporate community engagement, clear regulatory frameworks, and consistent monitoring. Future research should consider longitudinal approach and evaluate the impact of climate variability. In conclusion, preserving Denbiq Wetland requires an integrated strategy that balances ecological integrity with local socio-economic realities. With appropriate policy support, community participation, and sustainable practices, the wetland can continue to provide essential ecosystem services for generations to come.

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Additional information

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The author has declared that no competing interests exist.

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Data availability

Data supporting this study are available from the corresponding author upon reasonable request.

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